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THE WEAVING OF THE RED-BILLED WEAVER BIRD IN CAPTIVITY

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INTRODUCTION

It is among the weaver birds that we find the art of nest-building developed to its greatest perfection. Their nests are models of bird architecture and represent the climax of avian effort at home making.

"Instinct and necessity have made these birds wonderful architects. Natives of a land where the rays of a vertical sun alternate with tropical rains; where monkeys, serpents, and all kinds of other enemies abound, the weaver bird has learnt to avoid these manifold dangers for his progeny. . . . In its details the nest of each species of weaver bird varies, but all of them are more or less ball-shaped. The roof is always very thick and substantial enough to keep off the heaviest downpour, as well as to protect the inmates from the tropical sun. The nest is invariably suspended from frail branches or reeds just strong enough to bear its weight, but never strong enough to tempt any predatory animal to climb up. The entrance to the nest is invariably from underneath, a sort of ridge dividing the nest proper from the entrance, and preventing eggs or young from falling out. No bird of prey can therefore possibly see the contents of a weaver bird's nest, much less commit any ravages on a brood." [1]

Review of the Literature

For a long time ornithologists have been interested in the nests of the Ploceidae and while a great deal has been written about them, no one, as far as I have been able to ascertain, has ever described the actual details of the methods of nest construction in any species of weaver birds, or, for that matter, in any species of bird. This may seem to be a hasty statement, but a thorough search in the literature of this subject has failed to produce a single article of the nature sought for, the nearest and best attempts being those conveniently collected by Dr. A. G.

[1] Blackston, W. A., Swaysland, W., and Wiener, A. F. The Book of Canaries and Cage Birds, British and Foreign, p. 404.

Butler in his work on "Foreign Finches in Captivity."[2] But these deal only with the larger features of nest-building. Plenty of good descriptions of these larger features have been published for many of the Ploceidae, notably those just referred to, those in the works of Shelley,[3] Chapin,[4] Stark and Sclater,[5] Bates,[6] etc., to mention just a few of the more important ones. Bartlett's unfinished monograph of the weaver birds does not go into as great detail in the matter of nidification as a monograph might, and, as far as the present paper is concerned, adds nothing to those mentioned above.

As far as the particular species under discussion in this paper, *Quelea quelea* (*Quelea sanguinirostris*), is concerned, good descriptions of its nesting habits have been published by Blackston, Swaysland and Wiener,[7] by Butler, Shelley, and others, but all, as I said before, deal only with the gross aspects of the building process.

In view of the lack of the literature on this point, it may not be amiss to present herein a study of the actual weaving of one of the commonest species of Ploceidae, the Red-billed Weaver.

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[2] Butler, A. G., 1899, Foreign Finches in Captivity.
[3] Shelley, G. E., 1896, Birds of Africa, Vol. IV.
[4] Chapin, J. P., 1917, Classification of the Weaver birds. Bull. A.M.N.H. Vol. XXXVII, Art. IX, pp. 243-280.
[5] Stark and Sclater, Birds of South Africa, Vol. I.
[6] Bates, G. E. Ibis., Jan., 1909, p. 44; Ibis, 1911, p. 589.
[7] See[1] pp. 408-409.

FIG. 130. WEAVING OF WEAVER BIRDS IN THE PERCHING BIRDS' HOUSE IN THE ZOOLOGICAL PARK

1. Nest recently started, showing vertical loop. 2. Completed nest. 3. Part of playground. Photographed two years after the studies were made.

THE WEAVING OF THE RED-BILLED WEAVER BIRD, *QUELEA QUELEA* IN CAPTIVITY

By Herbert Friedmann

1. General Features of Nest-building

The general features of nest construction in this species have been described in more or less detail by several writers referred to above. Therefore I shall pass over this phase of the subject in a hasty manner and, were it not for the fact that in captivity the birds build nests quite unlike those built by the same species in nature, I would scarcely have touched upon it.

Not only did the nests built in the Zoological Park differ from those in nature, but also from those built in the aviaries of Dr. A. G. Bulter in London where, to judge by his descriptions, the nests built in captivity agree with those built in a state of nature. I cannot, and do not attempt any explanation for the discrepancies between the nests in captivity as I found them and those in nature or in the London aviaries.

In nature, the nest of the species is described as a more or less globular nest with an entrance hole on one side. In captivity the nest was really cup-shaped and had an arched roof which was attached to the nest proper at the two ends of the major axis of the slightly elliptical margin of the cup, and free on the sides. If the roof had been adnate to the bowl around its entire edge, the nest would have been truly globular. Mr. Chapin, whose wide field acquaintance with the Ploceidae gives his statements the stamp of authority, writes me that "ordinarily no weaver would leave a part of the roof open as in your sketch. Building is generally begun by weaving an upright ring at about the middle of the nest-to-be, and then adding the back of the nest, and the front, with entrance. So far as I know they never begin by constructing a simple cup-nest like a vireo."

In Reichenow's Vogel Afrikas III, p. 109, von Heuglin is quoted to the effect that while the subspecies *aethiopica* built

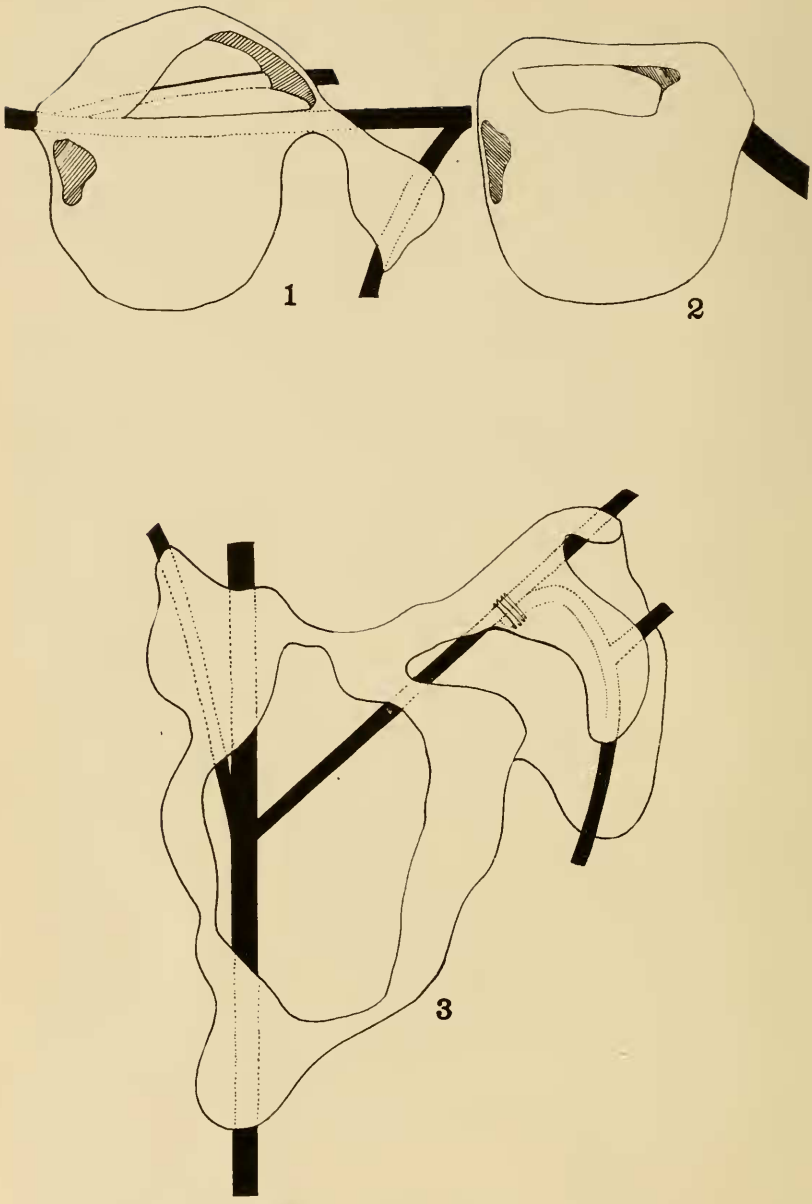

FIG. 131. OUTLINE DRAWINGS OF TWO NESTS AND PART OF A PLAY-GROUND BUILT IN CAPTIVITY.

purse-shaped nests in the Gardens at Khartoum, especially in Parkinsonias, they seemed never to lay in them.

The South African species is said to be parasitic. This is probably an error.

The two nests built by this species in captivity and part of the "playground" are shown in outline sketches (Fig. 131). It will be noticed that the two nests are very dissimilar in the degree of curvature of the roof but that they agree in having the roof partly free on the sides. The "playground" consists of perches, arches and runways, connecting the nests.

When building, *Quelea quelea* usually selects a fork of a branch and weaves a small mass of fiber or whatever material it may have (raffia in this case) right in the crotch of the fork. From this as a basis it forms a hoop nearly vertical as a rule. "From this hoop it works, starting from the bottom and gradually filling in the back, finishing off with the front, in the center of which it leaves a small hole to enter by." [8]

2. Details of Weaving

At the time this study was begun, there were nests already built, and also a large mass of what we may collectively call the "playground." This gave the birds two different types of sites for weaving—the first being the bare twigs around which they might weave, the second being the already existing woven foundations (nests and playground), to which they might add by weaving.

There seemed to be different types of stitches employed by *Quelea quelea* when weaving on a previously woven foundation than when weaving around a branch or twig. In describing stitches, I believe that diagrams are clearer and more eloquent than words, and consequently this text is largely an explanation of the accompanying plates.

When weaving around a twig or branch, *Quelea quelea* used three types of stitches as illustrated (Fig. 132). The arrows indicate the direction of the progress in making the stitch; the

[8] Butler. A. G., 1899. Foreign Finches in Captivity, p. 229.

dotted lines represent the strand of raffia as being on the far side of the twig, i.e., the portion that would be hidden by the twig in this view. (1) shows what seems to be a stitch used chiefly in conjunction with that shown in (2). Here the bird places a strand longitudinally along the branch, pushes one end around the twig, catches it on the other side, carries it up and over, tucks it under the part of the strand lying lengthwise along the branch, pulls it through and then tightens it with jerks of its head, seizing the strand nearer the knot with each jerk, until the knot is tight. In all weaving, the bill is the weaving organ, taking the place of a hand, the feet being used merely to clamp the straw down to the twig and hold it there.

In (2) is illustrated the simplest and most commonly used of all the stitches. The diagram should be self-explanatory, the stitch consisting in merely laying a strand longitudinally along a branch for about half its (the strand's) length and winding the remaining half around and around to hold it there. When the end of the strand is reached it is tucked in as in (1).

A variation of the type shown in (1), is illustrated in (3). This type is apparently rare as it was seen but once out of hundreds of stitches observed. It was used to tuck in the end of the strand at the completion of a stitch of the type shown in (2). All these three types were used when weaving on straight limbs.

When weaving at a fork the birds did one of two things: Generally they wove a solid compact mass of straw on the two arms of the fork before stretching a single strand across. However, they sometimes, though seldom, stretched a strand across before weaving any foundation on either side. They would straddle the fork, one foot on each side, just as far apart as possible. At times the distance between their feet was more than twice the width of the body! Then they would fasten the ends of the strand on either end by a stitch as shown in (2) and (1), Fig. 132. However, when the birds did act as above, they invariably drew the straw down to the crotch of the fork after they were through. Evidently they have no liking for frail suspension bridges.

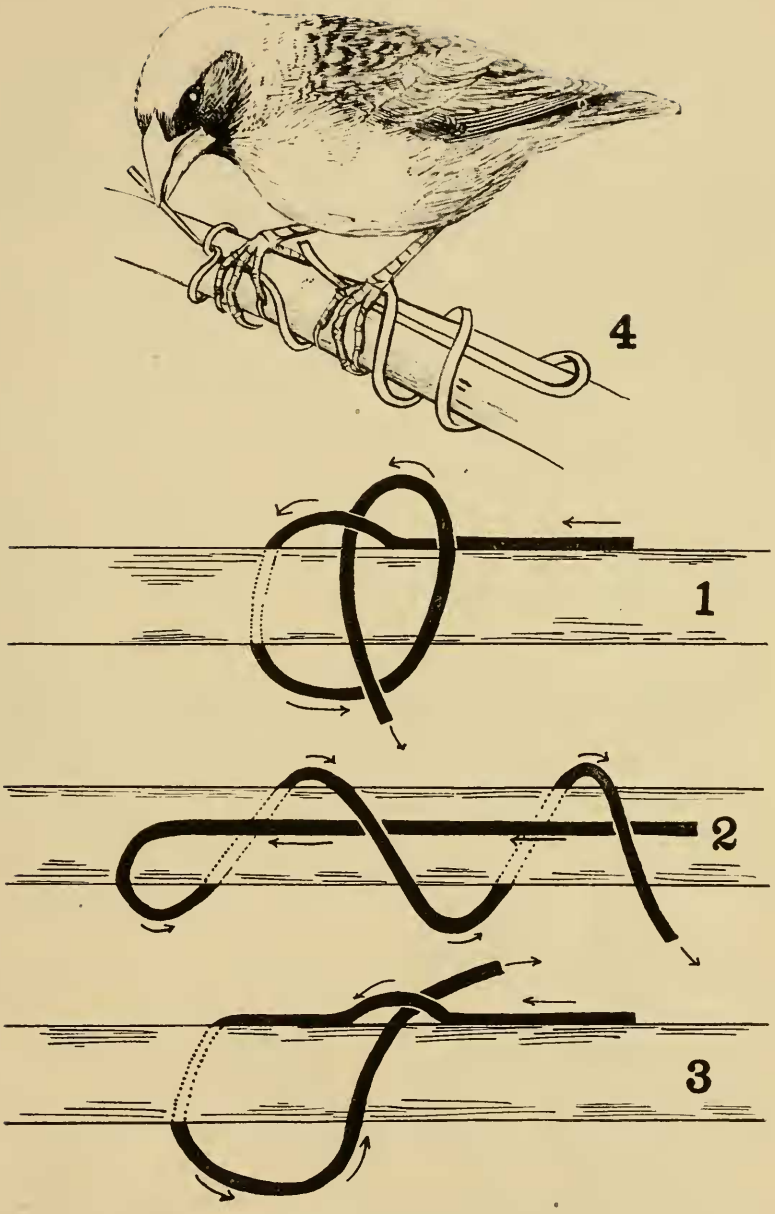

FIG. 132. TYPES OF STITCHES USED BY *Q. QUELEA* WHEN WEAVING AROUND A BRANCH

(4) after drawing by James P. Chapin.

When the birds were weaving on an old foundation of straw previously woven, their stitches were quite different from any of the preceding. In Fig. 133 the stitch is shown in detail in (1 to 10 incl.). The arrows indicate the direction of movement of the straw, dot-and-dash lines represent the straw being pulled through the mass of straw foundation, and dotted lines indicate the straw being on the other side of the mass.

The letter A marks the place in each case where the bill was applied. Briefly, the stitch is as follows: The bird holds a strand near one end in its bill and pushes it through the already existing woven mass (represented in the diagram by the space between the two parallel horizontal lines) as in (1). Bending over, it pulls the strand until one end is through as in (2-4). Then the bird takes the strand around the back of the mass (5-6), and repeats the process (6-9), the next time winding it in front of the mass as in (10). This stitch formed by far the greatest part of all the weaving done by *Quelea quelea.*

Especially interesting are (6′) and (7′) as indicative of the intelligence of these birds. In (6′) the bird made a knot by pulling the strand through the loop. Then on pulling at (A) (6′), to draw the knot tight, the bird evidently noticed that the part of the strand (B) (6′) was being drawn through the woven mass more and more with each tug at (A). The bird then tucked (B) under the loop (C) (7′) and then went back and jerked at (A) without any danger of pulling the strand out!

The weaving done by *Quelea quelea* is not only intricate and beautiful but it is strong and serviceable. I tried to pull down some straw the birds had woven on the wire netting of the cage. In one case the straw was attached only at one end, the other end dangling freely. I pulled with a force that I estimated to be over ten pounds, and the straw broke but the knot did not undo itself! On the contrary it seemed to become tighter.

The speed with which the birds weave is subject to great variation. All the straws used were of approximately equal length (one foot) so that in comparing speed, the comparison was a fair one. The speed varied from forty-eight seconds to

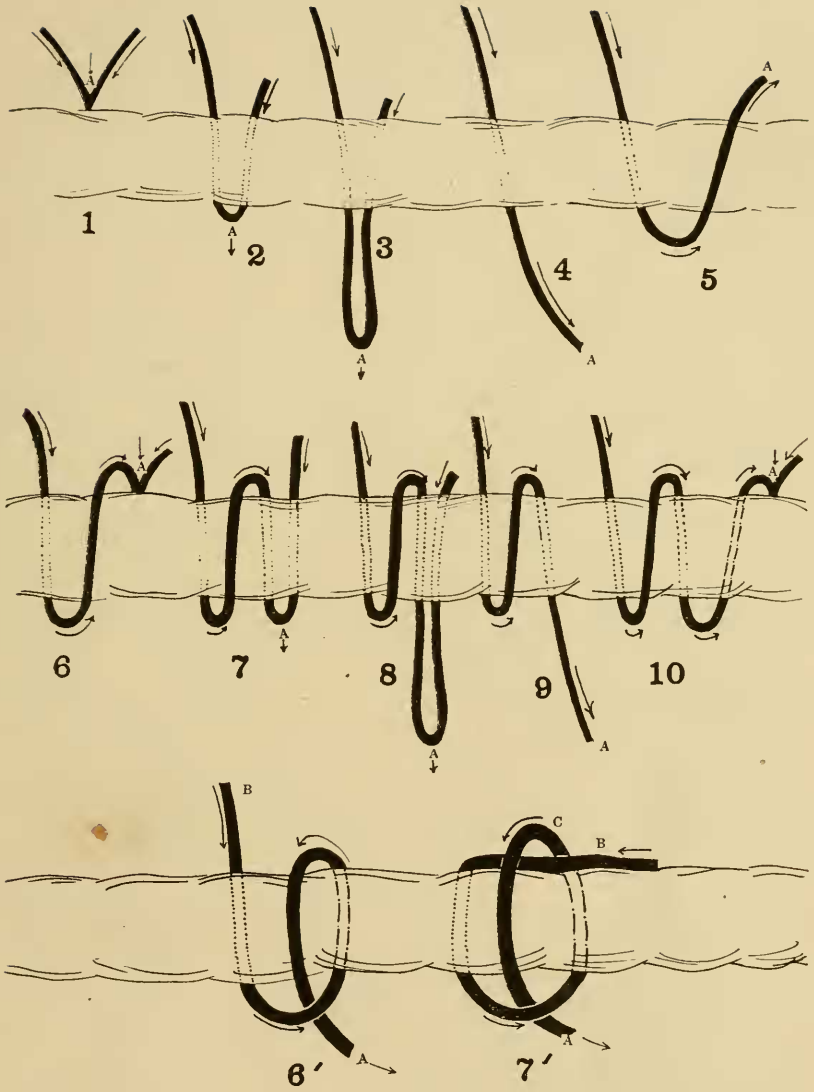

FIG. 133. STITCHES OF WEAVER BIRD OVER AN OLD FOUNDATION.

over thirty minutes per straw. Of course in winding around two twigs it would naturally take less time to use up a straw on a twig of greater diameter than on a smaller twig, there being fewer revolutions necessary in the former case.

The relation between the bill and the feet in weaving is interesting. The birds always pick up the strands with their bills, but invariably hold them down on the twigs or woven masses with their feet. A highly specialized case of correlated action is shown in Fig. 134. The bird pushed the strand underneath its toes as in (1-3). Then it took one end of the strand around the twig as in (4), and tried to push it under between its toes. (4A) shows the same position as (4) but from another view. Then to facilitate matters, the bird raised its middle toe, thereby loosening the straw and allowing the bill to work its way under and make the knot. This was observed but once, so that it is evidently not a general practice with *Quelea quelea*, but nevertheless serves to emphasize the degree of skill and intelligence with which these birds are endowed.

The discrimination shown by these birds in their nest making is little short of amazing. The location for permanent weaving is chosen only after many trials of various places. They are extremely critical of their weaving, often pulling out part of their nests and weaving it over again. In one case a bird pulled the same straw out eight times before it was satisfied with the manner in which it was woven. The general practice was this: A bird would weave in a strand, wipe its bill on the twig and then view its work from all sides. Then if not satisfied, it would try to mend it or pull it out entirely and try again. The weaving had to be compact or it was not satisfactory. Often the birds would pull and pull at a straw, each time jerking their heads back and forth with such force that it was a wonder that they could stand the strain. The discrimination of *Quelea quelea* with regard to color is fully described under Color Preferences. Suffice it to say here that red was the favorite color and orange next, while green, black, blue and violet were not used to any great extent.

The birds also showed considerable discrimination with regard to the width of the straws used. They preferred thin, fine

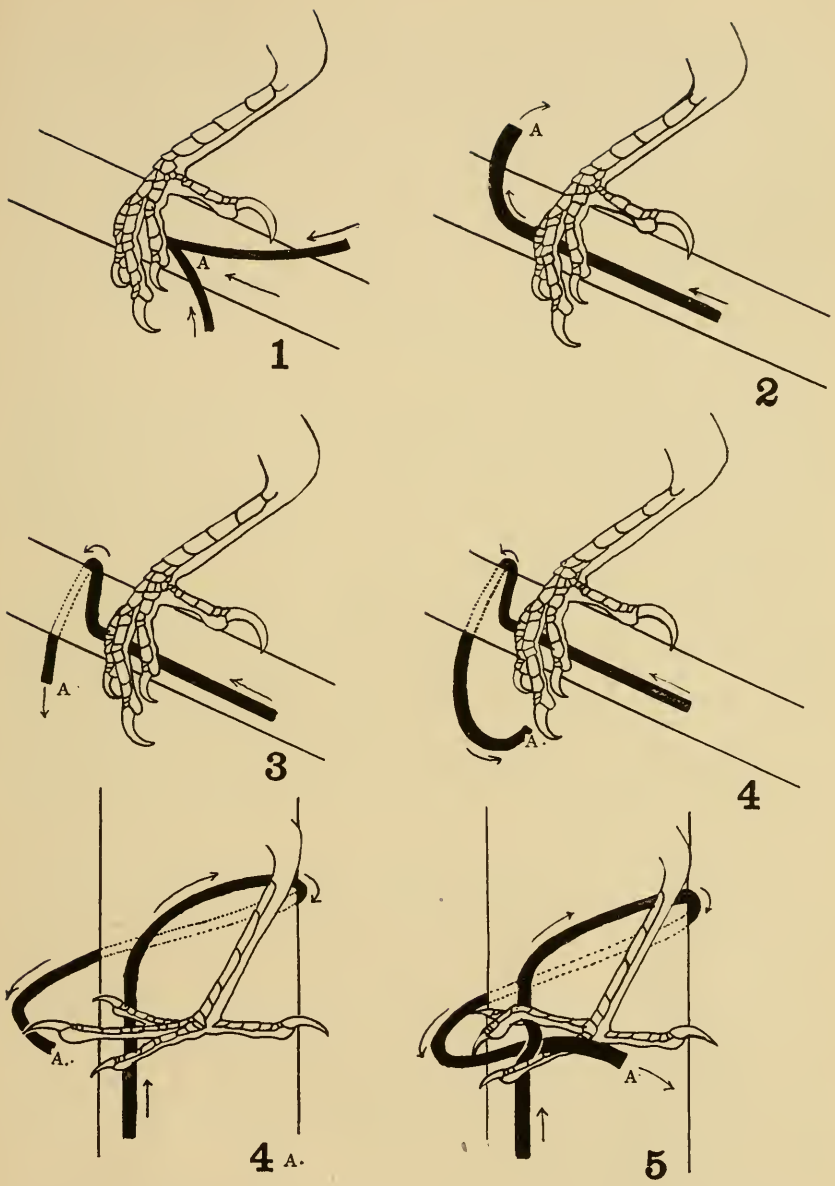

FIG. 134. HIGHLY SPECIALIZED CORRELATED ACTION BETWEEN BEAK AND FEET.

(1-4) Figure of foot after drawings by James P. Chapin.

straws to coarse, heavy ones. In fact, on numerous occasions, after stretching a strand across a fork, a bird would peck at the middle of the strand until the raffia would split longitudinally. Then it would pull on one side, thereby elongating the split until the entire length was divided into two thin strands where there had been but one wide strand. *Quelea quelea* is about as active and tireless a nest builder as one can want. The birds are always building new nests or playgrounds and when they have no building material, they busy themselves with repairing or even tearing down the old nests only to rebuild them and tear them down again. In his activity and "restless anxiety to weave nests, anything comes handy to the Red-beaked Weaver-bird, and a small finch coming near him would at once find himself minus a wing or tail feather, a friendly pecking at the neighbor's plumage being more convenient to the Red-billed Weaver than a search after a bit of fibre."[9]

This restless desire to build seems not to be restricted to *Quelea quelea* for Bates[10] writes of *Ploceus cucullatus* that ". . . . . tearing down their nests only makes them build the more furiously. They have a perfect mania for building, and when not building new nests are all the time repairing the old ones. They often destroy palm trees by stripping them bare of their leaves."

There was much keen rivalry between birds for straws. If one bird picked up a straw and dropped it, another bird was sure to pick it up in preference to any other straw, regardless of color or width. It was not uncommon to see two birds, one on each end of the same strand pulling in opposite directions. The birds sometimes tried to frighten each other away from their nests by spreading out their wings, somewhat in the style of the intimidation display of the white-breasted nuthatch, as described by Allen[11], lowering the head, opening wide the bill and uttering a harsh scolding note.

[9] Blackston, W. A., Swaysland, W., and Wiener, A. F. Book of Canaries and Cage birds, British and Foreign, p. 404.

[10] Bates, G. L. Ibis, Jan., 1909, p. 44.

[11] Allen, A. A., Bird Lore, Vol. XXI, No. 1.

The presence of crowds of people tended to make the birds more active, as on Sundays when thousands of people watched them during the day. Ordinarily the birds were most active from 10:00 A.M. to 11:00 A.M.; least active, or rather inactive from 11:00 A.M. to 2:00 P.M.; and active again from 2:00 P.M. to 4:00 P.M. If no crowds were present the birds would tend to sleep from 11:00 A.M. to 2:00 P.M., a habit reminiscent of their lives in tropical Africa.

Color Preferences

In studying the stitches used by the birds it was found convenient to use various colors of raffia so that each stitch would be easy to follow through. Incidentally it was found that the birds seemed to have a definite preference for certain colors, chiefly red and orange.

In testing for color preferences, the method used was as follows: Seven colors of raffia were used, the raffia being of exactly the same texture as the raffia the birds had been using for some months previously. The colors used were red, orange, yellow "natural," blue, green, violet and black. There was no noticeable difference between these straws in any respect except as to color. They were tested for taste and no difference in taste was found for any color. They were tested for weight, and found alike. Tests were also made for strength and texture, and all gave similar results. Therefore it was safe to say that the straws were exactly alike except in color. (The term straw as used in this paper refers to a piece of raffia. The term is used merely for convenience.)

Thirty-six equal sized pieces of each color raffia were distributed over the floor of the cage at the end of the day, care being taken to see that the colors were evenly scattered. The birds did not venture to touch the strange material until the next morning. By watching them all the next day (from 10:00 A.M. to 4:00 P.M.), I was able to record just how many pieces of each color each species took, used or rejected. Then, at the end of this day, I added to the raffia previously put in, the same number of pieces of each color as the birds used up during the day.

This was repeated each day for four days. Then the ex-

periment was repeated nineteen days later and carried on for three days. Thus every day the birds had thirty-six pieces of each of the seven colors or two hundred and fifty-two pieces of raffia in all to start with. Therefore, by adding together the results of the different days' tests for each species, I was able to find what colors each preferred and what each disliked. The possibility of the birds using up the colors of their preference and then, through lack of these, having to use other colors was eliminated by starting them off in the beginning with more of each kind than they could use up in a day and by adding each day just what they used up as described above.

All the straws used in the experiments were of equal thickness and about a foot long, this length being chosen because it satisfied two conditions: it was long enough for the birds to use with comfort, and at the same time it was short enough to enable each bird to use quite a few pieces each day. This latter condition was essential if any appreciable number of records were to be obtained.

The experiments were extended not only to include *Quelea quelea,* but also its close relative *Quelea russi,* the Russ masked weaver bird. There were five individuals of the Red-billed Weaver and three of the Russ Masked Weaver under observation. The following table illustrates graphically the substance of the present paragraph:

RED-BILLED WEAVER, *Quelea quelea*
(5 individuals)

	RED	ORANGE	YELLOW	GREEN	BLUE	VIOLET	BLACK
Used	59	27	22	8	11	7	3
Rejected	0	0	3	10	3	5	2
Total	59	27	25	18	14	12	5
Percentage Used	100	100	88	44	78	58	60
Percentage Rejected	0	0	12	56	22	42	40

RUSS MASKED WEAVER, *Quelea russi*
(3 individuals)

	RED	ORANGE	YELLOW	GREEN	BLUE	VIOLET	BLACK
Used	21	20	7	3	1	3	3
Rejected	0	0	0	3	1	0	0
Total	21	20	7	6	2	3	3
Percentage Used	100	100	100	50	50	100	100
Percentage Rejected	0	0	0	50	50	0	0

It will be seen at a glance that in numbers of straws used by *Quelea quelea*, red is more than double orange which, in turn, is greater than yellow, etc. In numbers of straws rejected, that is, picked up by the birds and then voluntarily (apparently) rejected, green leads with ten, while red and orange were never rejected. In this connection I may say that I counted as rejected those straws, the rejection of which appeared to be voluntary on the part of the birds. Several times a bird picked up a straw and was chased by another bird or frightened by some noise, and dropped the straw and flew off to a perch. These cases are not counted here, as they evidently have nothing to do with color rejection. Several red and orange straws were rejected in this way. In view of this it may be that the figures given in the table are not wholly correct but the general results are probably very nearly true. While the preferences may not be as marked as the figures would indicate, we must admit the existence of these preferences. The accompanying graph (Fig. 135) represents the color preference of *Quelea quelea* as interpreted by the number of straws of each color used by that species.

If we add the number of straws used and the number rejected for each color and then find that what not that percent of the total number of each color was used we find the preference to be:

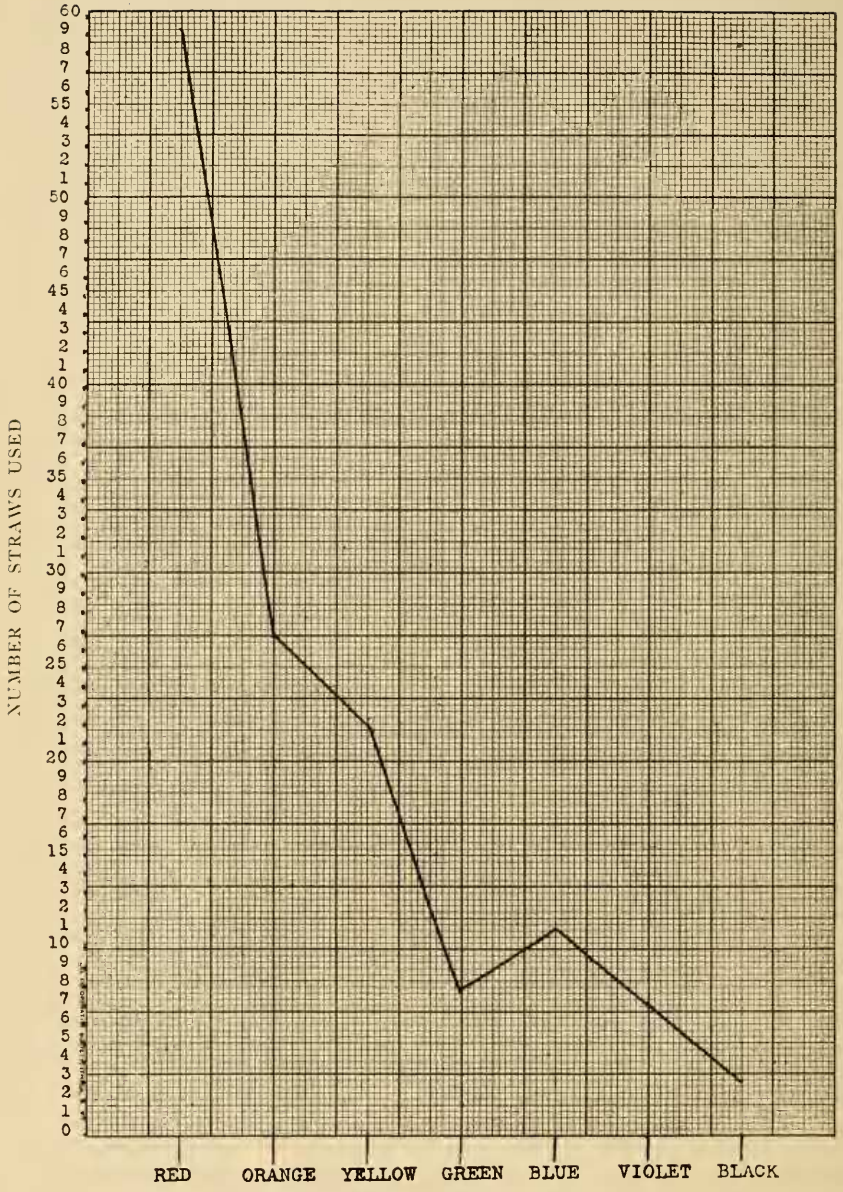

FIG. 135. GRAPH SHOWING COLOR PREFERENCES OF *Q. QUELEA*.